

1 **WHAT IS CLAIMED IS:**

2 1. A plant system for producing a heterologous protein under  
3 defined, controlled environmental conditions, the plant system comprising  
4 a plant (a) transformed with an expression vector comprising a gene  
5 coding for the heterologous protein operably linked to a promoter that is  
6 selected for optimal expression under the defined environmental  
7 conditions of CEA; (b) that produces a large amount of plant biomass  
8 under the defined environmental conditions, and (c) that produces tissue  
9 and tissue extract wherein the heterologous protein is stable.

10 2. The plant system of claim 1 wherein the plant is selected  
11 from the group consisting of *Solanum*, *Spinacia* and *Brassica*.

12 3. The plant system of claim 1, wherein the plant is *Solanum*,  
13 the promoter is light-inducible and the defined environmental conditions of  
14 CEA include at least 12 hours of light per day.

15 4. The plant system of claim 1, wherein the promoter is from  
16 the ribulose bis-phosphate carboxylase (Rubisco) small subunit gene.

17 5. The plant system of claim 1, wherein the promoter is CO<sub>2</sub>-  
18 inducible and the defined environmental conditions include between about  
19 350 and 2,500 ppm CO<sub>2</sub>.

20 6. The plant system of claim 1, wherein the promoter is heat-  
21 inducible and the defined environmental conditions include a temperature  
22 between about 28 and 40°C.

23 7. The plant system of claim 6, wherein the heat-inducible  
24 promoter is the promoter from the hsp80 gene.

25           8.     The plant system of claim 1, wherein the promoter is a  
26     chemically inducible promoter.

27           9.           The plant system of claim 8, wherein the promoter is  
28                         from the pathogenesis-related beta 1,3 glucanase  
29                         gene, lipoxygenase 1 gene or potato proteinase  
30                         inhibitor I gene.

31           10.          The plant system of claim 1, wherein the promoter is a  
32     dark-inducible promoter.

33           11.          The plant system of claim 10, wherein the promoter is  
34                         from the potato proteinase inhibitor I or  
35                         aminotransferase gene.

36           12.          The plant system of claim 1, wherein the promoter is a  
37     constitutive promoter.

38           13.          The plant system of claim 12, wherein the promoter is  
39                         from the tobacco rpL34 gene, the agrobacterium  
40                         nopaline synthase gene or the CaMV 35S gene.

41           14.          The plant system of claim 1, wherein the plant is potato  
42     which produces between about 0.2 and 5 kilogram fresh weight vines per  
43     plant.

44           15.          The plant system of claim 1, wherein the plant is mustard  
45     which produces between about 0.2 and 250 grams dry weight greens per  
46     plant.

47           16.          A method of producing heterologous protein in a transformed  
48     plant comprising the steps of:

- 49                   a.       transforming a plant with an expression vector  
50                               comprising a gene coding for the heterologous protein  
51                               operably linked to a promoter that is selected for  
52                               optimal expression under defined environmental  
53                               conditions of CEA;
- 54                   b.       cultivating the plant under the defined environment  
55                               conditions of CEA; and
- 56                   c.       extracting the heterologous protein.

57               17.    The method of claim 16, wherein the plant is selected from  
58               the group consisting of *Solanum*, *Spinacia* and *Brassica*.

59               18.    The method of claim 16, wherein the plant is *Solanum*, the  
60               promoter is light-inducible and the defined environmental conditions  
61               include at least 12 hours of light per day.

62               19.    The method of claim 18, wherein the promoter is from the  
63               Rubisco small subunit gene.

64               20.    The method of claim 16, wherein the promoter is CO<sub>2</sub>-  
65               inducible and the defined environmental conditions include between about  
66               350 and 2,500 ppm CO<sub>2</sub>.

67               21.    The method of claim 16, wherein the promoter is heat-  
68               inducible and the defined environmental conditions include a temperature  
69               between about 28 and 40° C.

70               22.The method of claim 21, wherein the heat-inducible promoter is  
71               the promoter from the hsp80 gene.

72               23.    The method in claim 16, wherein the promoter is chemically  
73               inducible.

74 24. The method in claim 23, wherein the chemically inducible  
75 promoter is from the pathogenesis-related beta 1,3 glucanase gene,  
76 lipoyxygenase 1 gene or potato proteinase inhibitor I gene.

77 25. The method of claim 16, wherein the promoter is a dark-  
78 inducible promoter.

79 26. The method of claim 25, wherein the promoter is from the  
80 potato proteinase inhibitor I or aminotransferase gene.

81 27. The method of claim 16, wherein the promoter is a  
82 constitutive promoter.

83 28. The method of claim 27, wherein the promoter is from the  
84 tobacco rpL34 gene, the agrobacterium nopaline synthase gene or  
85 the CaMV 35S gene.

86 29. A method of making a plant system for production of a  
87 heterologous protein comprising the steps of:

- 88 a. identifying a plant that produces a large amount of  
89 plant biomass under controlled environmental  
90 conditions, that can be rapidly propagated vegetatively  
91 and produces tissues and soluble protein extracts that  
92 provide increased stability against proteolysis and  
93 other damage to heterologous protein targets;
- 94 b. transforming the plant with an expression vector  
95 comprising a gene coding for the heterologous protein  
96 operably linked to a promoter that is selected for  
97 optimal expression under the defined environmental  
98 conditions of CEA; and

99 c. selecting a transformed plant that (i) produces a large  
100 amount of the heterologous protein and (ii) the  
101 heterologous protein is stable in plant tissues and an  
102 extract made from the plant.

103 30. The method of claim 29, wherein the plant is potato and is  
104 selected to produce between about 0.2 and 5 kg fresh weight vines per  
105 plant.

106 31. The method of claim 29, wherein the plant is mustard and is  
107 selected to produce between about 0.2 and 250 grams dry weight greens  
108 per plant.

109 32. The method of claim 29, wherein the plant is potato and is  
110 selected to produce between about 10 and 1300 kg heterologous  
111 protein/acre/year.

112 33. The method of claim 29, wherein the plant is mustard and is  
113 selected to produce between about 8 and 1000 kg heterologous  
114 protein/acre/year.

115 34. The method of claim 29, wherein the plant is *Solanum*, the  
116 promoter is light-inducible and the defined environmental conditions  
117 include at least 12 hours of light per day.

118 35. The method of claim 34, wherein the promoter is from the  
119 ribulose bis-phosphate carboxylase (Rubisco) small subunit gene.

120 36. The method of claim 29, wherein the promoter is CO<sub>2</sub>-  
121 inducible and the defined environmental conditions include between 350  
122 and 2,500 ppm CO<sub>2</sub>.

- 123 37. The method of claim 29, wherein the promoter is heat-  
124 inducible and the defined environmental conditions include a  
125 temperature between about 28 to 40°C.
- 126 38. The method of claim 37, wherein the heat-inducible promoter is  
127 the promoter from the hsp80 gene.
- 128 39. The method of claim 29, wherein the promoter is a chemically  
129 inducible promoter.
- 130 40. The method of claim 39, wherein the promoter is from the  
131 pathogenesis-related beta 1,3 glucanase gene, lipoxygenase 1 gene  
132 or potato proteinase inhibitor gene..
- 133 41. The method of claim 29, wherein the promoter is a dark-  
134 inducible promoter.
- 135 42. The method of claim 41, wherein the promoter is from the  
136 potato proteinase inhibitor I or aminotransferase gene.
- 137 43. The method of claim 29, wherein the promoter is a  
138 constitutive promoter.
- 139 44. The method of claim 43, wherein the promoter is from the  
140 tobacco rpL34 gene, the agrobacterium nopaline synthase gene or  
141 the CaMV 35S gene.